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AUTHOR Greenfield, Patricia Marks
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ABSTRACT

This paper discusses the role of attention to uncertainty in mediating the transition from sensorimotor activity to language. It is proposed that language from the very beginning is used to resolve uncertainty by selectively marking points of change, deviation from the familiar or choice from among alternatives. Several research findings are summarized in order to support this proposal: (1) Young children selectively give linguistic mention to the variable element in both linguistic and non-linguistic sequences of behavior, whether it be mention of object, persons, or actions. (2) Young children's natural speech rarely includes mention of an agent, except in cases involving uncertainty. The agent seems to drop to background awareness if it is an invariant feature of the situation. (3) The uncertainty which young children orient to cannot be equated with the concept of importance or an absolute concept of salience. Entities that are most important to the child (self, mother) under normal circumstances recede to background awareness because they are taken for granted. The child orients to changes in states, and it is these which are expressed in speech. (4) The use of words to mark change or to partition alternatives holds across a wide range of semantic functions. Just as novelty is encoded in early development in response to visually or enactively presented situations, in later development novelty is encoded in response to linguistic situations. (Author/SS)

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THE ROLE OF PERCEPTUAL UNCERTAINTY IN THE TRANSITION TO LANGUAGE

Patricia Marks Greenfield

University of California, Los Angeles

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Paper presented in a symposium on the transition from sensorimotor to linguistic communication at the Biennial Meeting of the Society for Research on Child Development, San Francisco, March, 1979.

This paper will treat attention to uncertainty as a perceptual structure which mediates the transition from sensorimotor activity to language. The guiding idea is that the attentional system is geared to resolve uncertainty from the very beginning of life and that language use is coordinated with this system as it emerges.

Uncertainty, Selective Attention and Selective Word Use

Uncertainty, as the term is used in semantic information theory (developed by Carnap and Bar-Hillel [1953]), exists to the extent that there are alternatives in a given referential situation. The alternatives may exist across either space or time. A message element is informative to the extent that it resolves uncertainty by selecting from among the possible alternatives. Probably the most basic form of uncertainty is change. The presence of an object against a plain background creates a visual change at the object's edges--the perceived alternatives are figure and ground. Object movement produces still further change, for movement creates alternative positions across time. According to the research of Kagan and others, contrast and movement are the prime determinants of visual attention during the opening weeks of life (Kagan, 1970b). Later in the first year, children build up internalized schemas which form a standard against which change is assessed and, most important, moderate discrepancy from such schemas attracts the infant's attention (Kagan, 1970a). Our hypothesis is that language is from the beginning used to resolve uncertainty by selectively marking points of change, deviation from the familiar, choice from among alternatives.

Another way of putting this claim is to say that principles of selective attention become principles of selective word use and that, thus far, the

construct encompassing the deployment of attention across the widest range of concrete situations is the concept of uncertainty. Our research has investigated the notion of uncertainty using naturalistic data and experimental techniques. In general we have found that, at the one-word stage, children selectively use their single word to express that aspect of a situation where alternatives exist or where there is change over time (Greenfield and Smith, 1976; Greenfield, 1978; Greenfield and Zukow, 1978).

Some Empirical Support

In our earliest research (Greenfield and Smith, 1976; Greenfield, 1978), sources of perceived uncertainty were indirectly inferred from an analysis of the naturally occurring referential situation in relation to the child/speaker and his utterance. Such analyses provided a rich source of hypotheses, but we have been moving toward more direct tests of our hypotheses: through, on the one hand, experimental manipulation of alternatives and change within a potential referential situation and, on the other hand, through observation of the child/speaker's visual attention and behavioral construction of alternatives.

First, an example of experimental manipulation: in a study with Zukow (Greenfield and Zukow, 1978), we created individualized scripts for mothers based on a particular child's own word use and vocabulary, and embodying particular patterns of constancy and variability. For example, the mother might tell the child to take off a series of items of clothing, e.g., hat, jacket. Here action is constant, while object of action varies. Or, in the opposite case, she might tell the child to first put on a hat and then take it off. Now action is variable while object remains constant. A prerequisite for such a procedure is that the child have the vocabulary to express either

the change of state (on, off) or the items of clothing (hat, jacket, for example). What we have found is that children will selectively imitate the variable element as the sequence unfolds. Where object varies, the child will mention the object name; where action varies, it will be the action which receives linguistic mention. This type of procedure, while involving experimental manipulation of variability, has the weakness that the variable element in the nonverbal referential situation is also the variable element in the mother's verbal instructions. Systematic data on spontaneous speech production were therefore needed to fill the gap, to demonstrate more conclusively that the child is responding to perceived uncertainty in the world, not merely to perceived variability in language.

The Case of the Missing Agent

Let me therefore proceed to some examples emerging from naturalistic observation. We have observed that, in the one-word stage, so-called "rich interpretation" of children's speech reveals very few mentions of an agent, despite the fact that children are often talking about events in which someone, an agent, does something (Greenfield and Smith, 1976). A close look at the exceptions to this rule reveals rather special circumstances in which the agent is mentioned, each circumstance related to a particular source of uncertainty. One circumstance is where mention of an agent implies the selection of a preferred agent from an ensemble of alternatives. The following example comes from a few hours spent with an Italian child (pseudonym, Pietro) who was able to produce both single-word utterances and two-word sentences. Because of my limited Italian and interest in agents, I decided to observe every use of mami. In this time period, there was but a single use

of one of these forms in an agent context:

> I asked Pietro if he wanted me to open a juice can he was holding, saying aperto? (open?) and gesturing toward the can. He answered with mami, and proceeded to give the juice can to his mother.

In this situation, the child's behavior indicates that mami expresses his preference for his mother as agent, in contrast to me as an all-too-real alternative. This example illustrates how the child does not merely use his word to describe an agent who is acting, but rather to select an agent from among a set of possibilities created by the unfolding of events. That is, his mother did many different things within sight of Pietro in the course of the observation; yet he did not say mami on these occasions. In this example, the array of alternatives or ensemble, as it is called in information theory, is inferred from the fact that Pietro responds to my offer, which has implied myself as agent, and hands the juice can to his mother, implying her as agent.

The Child Constructs Behavioral Alternatives

The next example illustrates how the construction of alternatives can be observed more directly in the child's own behavior. This example is the only other use of mami in a single word utterance in the same time period.

> We have been playing in the park. Pietro has been throwing the ball to various people other than his mother. Now, he gets ready to throw once more, saying mami. Then he throws to this mother.

In terms of the behavioral sequence, Pietro has created a set of possible recipients. Examination of his sequential behavior indicates the ensemble of alternatives. The word mami indicates a desired change, as well as a selection from among the ensemble of possible recipients. But this example indicates a limitation to the value of the information theory metaphor for expressing our understanding of what the child talks about. In this case, there are

numerically more alternatives (potential recipients) than in the first example (potential agents). An information theory metric would say that there is therefore more uncertainty. Yet I would not want to claim that the probability of saying mami is greater in this situation than in the two-choice one. At this point in our research, I limit myself to the observation that, in both situations, mami functions to select from among alternatives; and that this state of affairs contrasts with other times mother was carrying out various actions, but Pietro did not use this word.

Selection from Alternatives as the Ontogenesis of Contrastiveness

Chafe's (1976) discussion of how linguistic content is transmitted (by adults) includes discussion of the device of contrastiveness. The function of a contrastive sentence is to assert which candidate is the correct one. The correct candidate is called the focus. According to Chafe, contrastiveness occurs against a context of background knowledge, which includes a list of possible candidates. According to Chafe, too, contrastiveness is a status not of a word but of its referent. From this it follows that the list of possible candidates need not exist on the linguistic level but may exist in the perceptual and/or enactive construction of the situation. Hence, Pietro use of mami to select an agent from a limited set of possible agents, against background knowledge of the ball game conforms to Chafe's definition of contrastiveness. An important difference remains: Chafe's notion is defined in terms of the speaker's knowledge of what is contrastive for the listener. It depends on inferences by the speaker about the listener. Our hypothesis is that contrastiveness begins its ontogenetic life independent of speaker inferences about the listener, determined only by what is contrastive for the

speaker in terms of his or her construction of the situation (e.g., Pietro's implicit list of possible recipients of the ball and his assertion of mami as the correct one). Adults, too, may rely on similarity between their own state of awareness and that of their listeners when that is possible. The state of the listener may well be computed as a separate state of affairs only when the speaker has reason to believe the listener differs from himself or herself in lacking some relevant item in immediate awareness. The existence of adult egocentricism (cf. Elkind, 1967) bears testimony to this idea of speaker rather than listener oriented devices by which background context influences what is being said.

According to Chafe, the focus of contrast is, in adults, generally distinguished by higher pitch and stronger stress. My hypothesis is that this stronger emphasis is conveyed, at the one-word stage, by linguistic realization itself, for the background information remains unexpressed. Thus Pietro's mami could become I throw to Mami at a more advanced stage of linguistic expression. In this hypothetical example, some of the background knowledge of the ball game is expressed in I throw, unrealized in the one-word version.

Uncertainty Made Explicit in a Question

Two-word utterances open up the possibility to make uncertainty linguistically explicit. The only other use of mami during this observation period is in a two-word utterance and illustrates another sort of perceived uncertainty. The situation is as follows: Pietro's mother has just left the terrace (where the three of us have been) to answer the phone. Pietro asks dove mami? (where's mama?). Here the additional word, the interrogative "where" makes

linguistically explicit Pietro's uncertainty about his mother's location. This example relates more to uncertainty in the everyday sense of the word. Berlyne (1974) connects this everyday meaning of uncertainty to the information theory concept by saying that the objective variability measured by information theory is usually what causes human uncertainty; i.e., uncertainty is the subjective result of variability in the outside world. Indeed, in the example under consideration it is external variability in the form of mother's change of location from inside to out which occasions Pietro's dove mami (where's mama).

These three examples gain additional force from the fact that this is an exhaustive list of occasions on which the word mami was used within the observed time period. In addition, because an advance decision was made to observe the usage of this particular word, there was no ex post facto selection of data.

The Missing Agent: A Perceptual Hypothesis

But let us return now to the initial observation that agents are rarely expressed in one- and even two-word utterances. Why is this the case, especially considering the often observed fact that children talk about action? What seems to happen at the one-word stage, for example, is that the message gets expressed by the action word alone rather than agent; e.g., Nicky, one of the children in the original study, says up climbing up a chair rather than Nicky. The situation is similar with an agent other than himself. When his friend Matthew is whining, he says crying rather than Matthew. I would like to develop an explanation for this phenomenon in terms of patterns of visual attention as these are affected by habituation to the familiar and an orienting response to the novel. In developing the argument, I want to

draw on the research of Robertson and Suci. These investigators find that when children at the one- and two-word stages watch filmed action involving an agent acting on an animate recipient in the presence of a bystander (that is, one puppet pushing another with a third looking on), they selectively attend to the agent rather than to the other two participants. And this tendency continues over several repetitions of the same action by the identical agent. But it is just such repeated watching which leads to habituation. And indeed, habituation to the agent, as assessed by heart rate measurement, is another phenomenon that manifests itself in their experiment. At this point, I should like to bring in Jeffrey's (1968, 1976) serial habituation hypothesis (and I am grateful to Roy Pea [1979] for suggesting the relevance of this concept.) This hypothesis, confirmed in a number of studies of young infants, states that habituation to the initially most salient feature of a stimulus enhances the possiblity of orientation to other features of the same stimulus. Here is a hypothetical picture of how this would apply to the infant who continues to watch the agent as action unfolds and is repeated. The invariant features of the agent would cease to attract focal attention whereas changing features would--and action represents just such change. Hence, the child who keeps his or her visual regard on a familiar agent over a period of time may well be orienting to action rather than agent, the agent dropping to background awareness. This orientation to the changing element would then be reflected in the child's deployment of the single word to express what is being done rather than who is doing it. Here is an attentional explanation of the general preference to verbalize action rather than agent when the one-word child is commenting on a situation involving an animate being engaging in an action.

Visual Orientation and Verbalization

Our most recent study incorporated direct examination of visual orientation in relation to word use. Leaper and Baker made some videotapes of children playing with their mothers. Play involved toys which were all familiar and nameable by the child. Each mother presented a scripted series of actions for the child to imitate. Within a particular series something varied (e.g., recipient of action) while other characteristics remained constant (e.g., action). An example of this would be a routine in which the mother fed the same food to a series of different animal puppets. In this sequence agent, action, and object remain constant while patient or recipient of action varies. Although the children often departed from the script, it did provide a semi-structured framework for the analysis of word use. The mothers were, moreover, instructed not to describe objects or actions verbally. Unlike the earlier study using selective imitation, therefore, variability in the event was independent of variability in the linguistic cues.

Let's consider one of the children in this study, an 18-month-old boy. He was the only one whose father was present during the experimental session. I want to compare patterns of visual attention and linguistic reference to mother and father. During the session, Ben (a pseudonym) has his attention focused on his mother most of the time. He is either looking at her from very close by (at a conversational distance) or is on her lap. While he has the word mommy in his lexicon, he never uses it in this situation. His father, in contrast, is at a distance from Ben. Ben does not seem aware of his presence at first. He has been playing with his mother at the beginning of the session. For some reason he turns and catches sight of his father in the corner of

the room. He points to him and walks toward him repeating daddy, daddy, daddy, daddy, although, when he reaches his father, he does not appear to want his father or want him to do anything. Here, an observable orienting response is joined with linguistic expression. And, indeed, this is the only time the word "daddy" is used during the session. Orientation to what, in this situation, is a new and possibly unexpected entity, appears to stimulate naming. Daddy is not mentioned again, thus confirming the role of novelty in visual orientation and speech. In sum, Ben never mentions his mother, although he interacts with her constantly, whereas he does mention his father despite the fact that he only notices him once and they never really interact.

The Unimportance of Importance in Selective Word Use

This example illustrates how uncertainty cannot be equated with the concept of importance, or an absolute concept of salience. Indeed entities that are most important to the child--self and mother--may be just those that, under normal circumstances, recede to background awareness just because of their stable presence, i.e., they come to be taken for granted. In the language of pragmatics they are presupposed rather than linguistically stated.

This analysis is paralleled by another phenomenon involving inanimate objects. We have found in a series of three studies that inanimate objects are more likely to be named by the child when they are at a distance from the child rather than in hand.[1] In line with my explanation in terms of visual orientation and habituation, tactile contact with the object in hand should stimulate habituation and withdrawal of the object into background awareness. Once again, the child should orient to change--here, to any change of state intended or produced in the object in hand. If language follows this orienting response,

[1]Bruner, Caudill, and Ninio (1975) have found that preverbal pointing, an indexical behavior that precedes labeling in development, also occurs in response to objects that are out of reach.

the child should comment on the change, while not mentioning the object itself. And this is exactly what we have found. A particularly interesting example comes from my longitudinal study.

> There are two kinds of car. One is the toy car Matthew is playing with inside the house. The other is real cars which can be heard to pass outside.
>
> As Matthew plays with the car in hand, he never mentions it, only talking about the action changes he is producing, expressed in words like bye bye, beep beep, down (throwing it.) Yet every time he hears a car pass outside his response is to name it saying car.

The car in hand comes to be taken for granted, habituated in attentional terms, and goes unmentioned. I infer that the cars outside, occasional and unseen, elicit an orienting response. And, correlatively, this orienting response is marked by the child's use of an identifying label. Once again, too, the child names what is less important in terms of relevance to his personal world (the passing car) while leaving unsaid what is of greater personal importance (the toy car in hand).

Constance vs. Change: The Ontogenesis of the Given-New Distinction

The example of daddy, above, could be used to illustrate the ontogenesis of the given-new distinction as articulated by Chafe (197): "Given (or old) information is that knowledge which the speaker assumes to be in the consciousness of the addressee at the time of the utterance. So called new information is what the speaker assumes he is introducing into the addressee's consciousness by what he says." (p. 30).

As in the case of contrastiveness, my hypothesis is that this distinction starts out and remains basically a speaker-oriented concept, without reference to the listener. With this in mind I should therefore like to modify the definition of given information as knowledge that is already in the speaker's

background awareness before the referential event occurs; new information is then what is introduced into focal attention by the referential event. Thus the mother, in the example above, is already a given at the time the observation session begins, whereas the father is observably introduced into the child's consciousness, as Ben's visual orientation to his father shows. Chafe gives as an example of old information the situation where, before the utterance, the speaker has seen the listener look at some object and therefore pronominalizes it. Our example, analyzed from a speaker-oriented perspective, would stress that, because the child-speaker has, up to the present, been in a communicative relationship with the mother, she has become a given and he therefore does not refer linguistically to her at all.

As for adult forms of expression, Chafe states that given information is conveyed in a weaker and more attenuated manner than new information. In one-word utterances, this attenuation of given information is carried to the extreme of disappearance: it remains unsaid. This is nicely illustrated by the child's general tendency to veralize action while omitting agent when describing his or her own action. Self, in the background of awareness, a constant for the child, is a given and goes unsaid. The action, representing a change of state, is what is new for the child. As such it gets verbalized.

It is important to note a refinement which I have introduced into Chafe's notion of consciousness--the distinction between background awarenesss and focal attention. These concepts bring Chafe's ideas into closer relation with psychological concepts and allow his distinction between given and new information to be more readily applied to perception of the extralinguistic context.

The Construction of Novel Alternatives: Evidence Against Situational Determinism

An exception to the rule about not mentioning what is in hand illustrates how novel alternatives can always be constructed by the child and that the principle of using language to resolve uncertainty is not a sort of situational determinism. In this example, Ben starts with a cookie in his right hand. He then says dog, moving the cookie from right to left hand, preparing to take the dog in the right hand. He says dog again while it is in hand. Although he names what is in hand, he has, through his action, constructed two alternative objects which can be held in his right hand, thus counteracting the tendency for object in hand to be taken for granted. (Next, putting the dog down, he says kie [seeming to be a short form of cookie] signaling a change of the cookie from right to left hand.) This example nicely illustrates Olson's (1970) theory of semantics, which stresses that words are used not simply to refer but also to partition alternatives.

The Use of the First Person Possessive

Finally, I want to illustrate how the use of words to mark change or partition alternatives holds across a wide range of semantic functions by examining the use of the possessives my and mine by one child in the most recent study. While there were many things belonging to this child (whom I shall call Rena) in the room during the type of structured play already described, the possessive forms my and mine were not used to identify them. Instead these words were applied to objects (sometimes hers, sometimes not) that were in her mother's possession, as she grabbed them away. So my and mine were not used to describe a state of affairs but rather do mark a change of possessive state, the act of taking possession, making something hers. Thus,

the first person possessive was not used where possession could most be taken for granted--to mark the child's own toys, for example--but rather where it was most uncertain, most in question.

Another example (from informal observation of my nephew Daniel, age 21 months) illustrates the interesting (albeit less common) use of the possessive to partition alternatives:

> Daniel, in the kitchen, communicates that he wants some raisons. His mother gives him two identical tiny boxes of raisins, telling him one is for him and one is to give to his friend (age 2), who is on the porch, out of sight. Holding one box in each hand, Daniel holds out one to his mother and says my. His mother agrees, and Daniel leaves the kitchen.

Differentiation of the identical boxes is required by Daniel's goal of getting some raisins and by the task set by his mother (and seemingly accepted by Daniel) of giving a box of raisins to his friend. The use of my partitions the alternatives that have arisen relative to this goal structure.

The partitioning of alternatives reappears in an important way in early dialogue (Greenfield and Smith, 1976). When Nicky is 20 months of age, his mother points to her books and says Those are mine. Nicky then points to his own books and says Nini (Nicky). This dialogue clearly implies an ensemble of books partitioned by the possessive terms.

Dialogue and Uncertainty

In adult initiated question-answer dialogue, furthermore, the question establishes certain information as given while identifying an area of uncertainty. Thus, what has been taken for granted earlier by the child is now put into words by an adult interlocutor. As Clark and Haviland (1977) put it, "questions have given information, but in place of new information they have wanted information."

Just as novelty was encoded a few months earlier in response to visually or enactively presented situations, now the child provides new information in response to a linguistic situation. By new is meant information not contained in the question itself, the wanted information. For example, I ask Matthew, age 20(26) where does it go? referring to a puzzle piece and he answers here, pointing to the correct hole. Thus the tendency to omit information already obvious on the perceptual level is now repeated in response to the linguistically given information of a question. What is presupposed by the question is omitted in the answer. This strategy can be seen as the earliest manifestation of Grice's (1975) conversational maxims relating to quantity: Make your contribution no less but no more informative than is required (for the current purposes of the exchange).

Further Developmental Continuities

Without getting into a discussion of presupposition and assertion in mature language, I would like to point out developmental continuities: The influence of orientation to change persists in our language usage as adults. Vygotsky (1962) pointed this out in this example from his classic Thought and language:

> Now let us imagine that several people are waiting for a bus. No one will say, on seeing the bus approach, "The bus for which we are waiting is coming." The sentence is likely to be an abbreviated "Coming," or some such expression, because the subject is plain from the situation. (p. 139)

In this setting--waiting for a bus--the constant, what can be taken for granted, is not mentioned, the change is. Wertsch, in a recent paper (1977) reminds us that inner or private speech, Vygotsky's language of self-instruction, also omits what is already known, what Vygotsky calls the psychological subject, and

includes what is new, Vygotsky's psychological predicate.

In conclusion, selective attention to change, variability, and novelty appears as important in language use as in perception. At this point in our research, we need better and more independent measures of orienting and attending while language is being produced. If such research should bear out our findings up to this point, then attention to uncertainty will furnish an important bridge from sensorimotor functioning to language.

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